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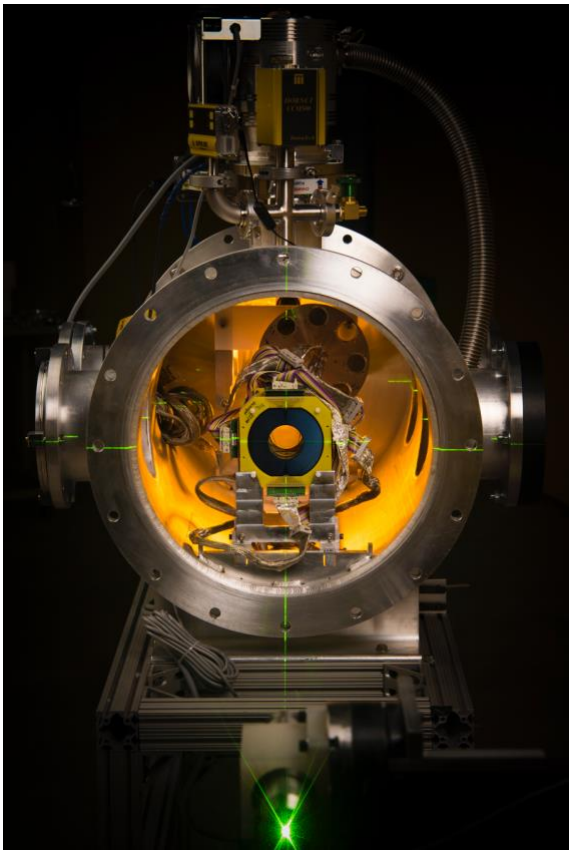
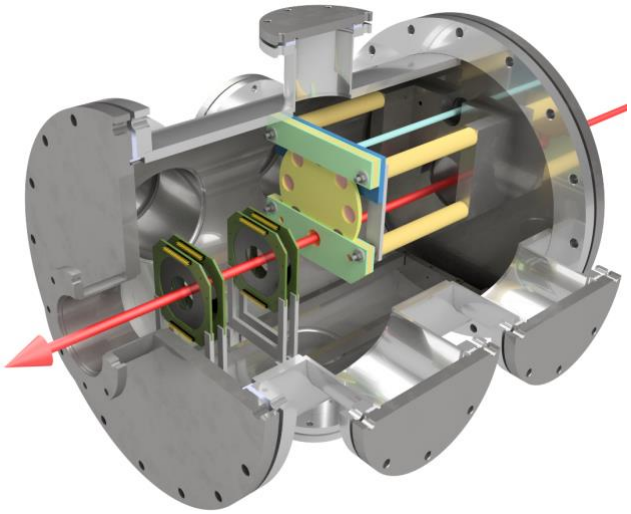
Overview of Flight paths
Flight path short description for 15R

4FP15R is dedicated to study neutron-induced charged particle reactions using the Low Energy NZ (LENZ) instrument with stable and radioactive samples. Applications include nuclear reaction studies, nuclear astrophysics, radiochemical diagnostics, and next-generation nuclear reactor design.

Flight paths
Target 4 Flight path 15R



The Target 4 Flight Path 15R is located in building 1302 with an available path length of 13 – 29 m from the T4 spallation target.
The long flight path length allows more than one experiment to be accommodated in parasitic mode if needed. This length also allows transmission measurements at neutron energy higher than 1 MeV to be performed. Sweeper magnets are located after the shutter and the last collimator in the flight path, in order to deflect charged particles generated from the spallation neutron target and along the flightpath in beam collimation materials. Flight path 15R has a variable jaw shutter with a maximum aperture of 4" square. This adjustable shutter aperture provides flexibility in delivered beam flux at the-sample location for the case of detector characterization measurements.



Schematic diagram of the LENZ instrument, composed of two sets of ΔE-E DSSD detector telescopes at forward angles, and a target wheel in the middle of the instrument. Red arrow shows the neutron beam direction.

Presently, the Low Energy Neutron-induced charged particle (Z) (LENZ) instrument is dedicated to measure neutron-induced charged particle reactions with large solid angle coverage and low energy thresholds. Implementation of *state-of-the-art* waveform digitizers enhance the power of the experimental system in separating and identifying different charged particles, obtaining improved timing- and energy-resolutions, and processing high throughput rates.

As shown in the schematic diagram of detector configurations, the LENZ is designed for flexibility in the detection of charged particles, energies, and solid angles by coupling a gas detector with silicon detectors. Each double-sided silicon strip detectors provide angular distributions from their 16 annular segmentations in order to improve the precision and uncertainty of measured differential cross sections. It has been demonstrated that the LENZ can provide the differential cross sections to discrete levels with angular distributions, within its experimental resolving power. The number of silicon detectors (detector thickness ranges from 60 micron to 1500 micron) can be easily reconfigured, in order to increase the solid angle or tune energy loss in the detectors. At the moment, the instrument is commissioned and well utilized, measuring (n,p) and (n,α) reaction cross sections with neutron energies up to 50MeV at the WNR facility.

Schematic diagram of the hotLENZ instrument, which is optimized for radioactive sample reaction studies at WNR. Light blue in the bottom shows the tungsten cask for shielding from the radioactive decay intrinsic to the sample. The sample manipulation is designed to be remotely controlled, minimizing personnel exposure.

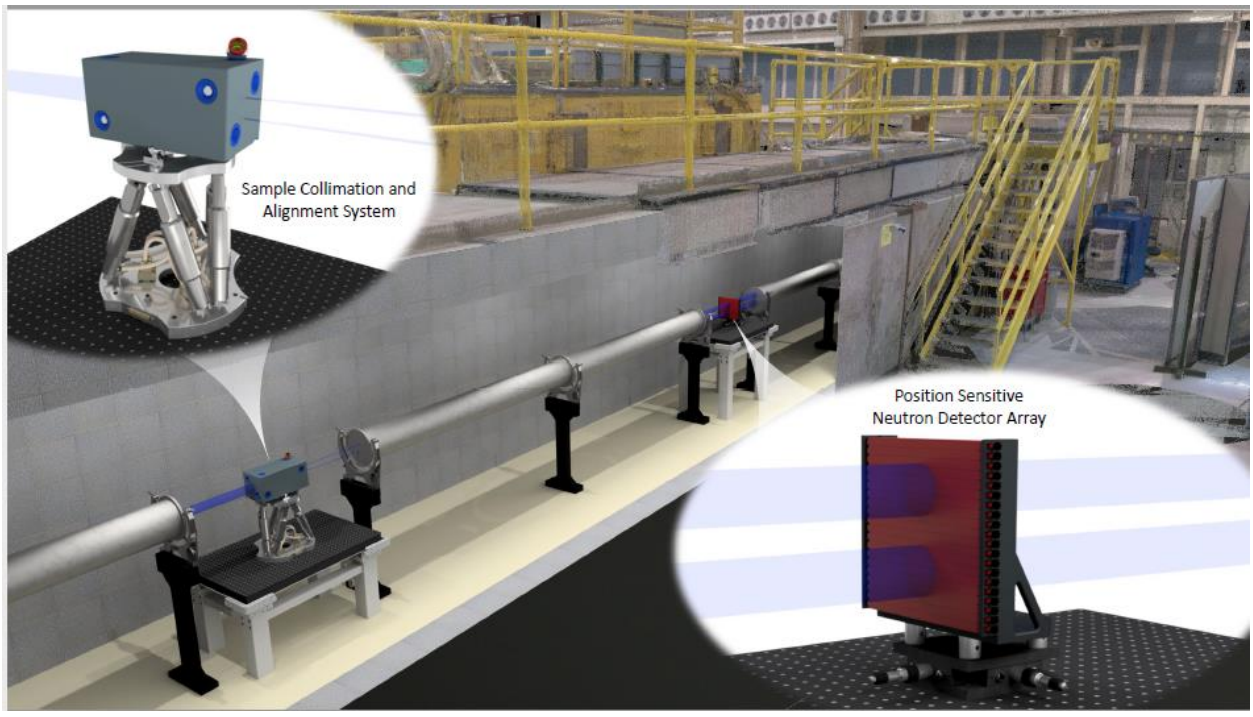
The hotLENZ experimental system is being developed to study (n,p) and (n,α) reactions with radioactive samples produced from the Isotope Production Facility at LANSCE. Due to the potential for high radiation dose rates, the sample transport and manipulation will be remotely controlled. The experimental system has also been designed for rapid assembly, minimizing personnel exposure while preparing for these reaction studies. Charged particle detection capabilities include double sided silicon detectors or a single crystalline diamond detector array. The experimental system can also be utilized at T4 90L flight path in order to utilize the higher neutron flux available below 5 MeV, in contrast to 15R (shown in the comparison of different neutron energy spectra at WNR). This expanded capability is useful for the case of low cross-section measurements which are typical of reaction studies of astrophysical interest.

"Science Thrust Areas"

DICER – Flight Path 13 Device for Indirect Neutron Capture Experiments on Radionuclides
Neutron total cross sections on radioactive samples

An instrument for making resonance neutron transmission measurements on very small radioactive samples to tightly constrain their neutron-capture cross sections.

DICER is being developed to measure neutron total cross sections in the resonance region on very small radioactive samples as an indirect means to tightly constrain their neutron-capture cross sections. Starting in October 2019 development will be accelerated through Laboratory Directed Research and Development Directed Research funding for three years. The main goals are to make proof-of-principle measurements on ^{88}Zr and ^{88}Y. As of July 2019, measurements are feasible on samples as small as 1 mm in diameter and source-to-detector flight path lengths of 65, 30, and 15 m (with samples at roughly ½ these distances) are available. Also, a filter box to facilitate background and other measurements has very recently been installed and soon will be tested. Current measurements employ a ^{6}Li-glass scintillator detector, and CLYC and plastic scintillator detectors are also available. Planned improvements include a sample collimator/changer/shield for radioactive samples as small as 0.1 mm in diameter and with activities as high as several Curies, and upgraded monitor and main neutron detectors.



Cutaway drawing of the planned upgraded main DICER apparatus.